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(54) **HIGH HEAT-RADIANT OPTICAL DEVICE SUBSTRATE AND MANUFACTURING METHOD THEREOF**

(75) Inventors: **Ki Myung Nam**, Cheonan-si (KR); **Tae Hwan Song**, Cheonan-si (KR); **Young Chul Jun**, Ansan-si (KR)

(73) Assignee: **Point Engineering Co., Ltd.**, Asan-si (KR)

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USPC 156/60, 77, 150, 151, 250, 272.2, 156/273.3, 273.9, 274.4, 307.1, 307.3, 156/307.4, 307.5, 307.7, 278, 280; 428/98, 428/119, 156, 172, 411.1, 457, 469, 471, 428/472.2, 413, 414, 416; 257/668, 700, 257/758, 88
See application file for complete search history.

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

DE	2065346 A1 *	5/1973	....	B32B 15/08
JP	09-055535	2/1997	....	H01L 33/00

(Continued)

OTHER PUBLICATIONS

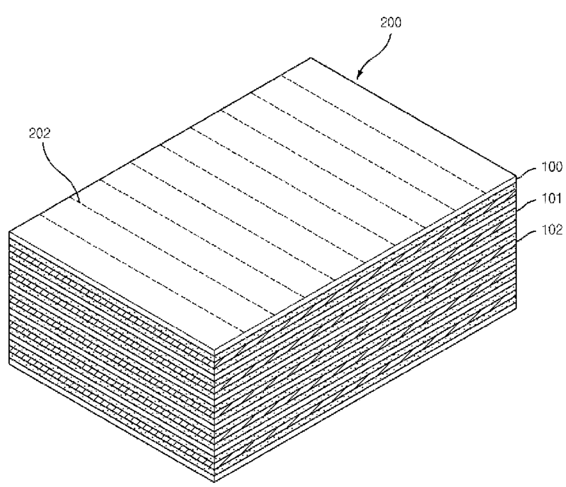
Korean International Searching Authority, International Search Report (WO 2013/002460 A2); PCT/KR2011/008943; May 17, 2012, 3 pages.

Primary Examiner — Philip Tucker
Assistant Examiner — Brian R Slawski
(74) *Attorney, Agent, or Firm* — Sunstein Kann Murphy & Timbers LLP

(57) **ABSTRACT**

The manufacturing of an optical device substrate is achieved by anodizing the surface of a metal plate, coating an insulative liquid bonding agent, having a viscosity which can permeate into an anodized film of the metal plate, on the metal plate, and alternately layering, pressing, and heat treating the metal plate coated with the liquid bonding agent and an insulative film bonding agent before the liquid bonding agent becomes solid so that bonding force between the metal plate and an insulation layer is strengthened, bubbles formation in the liquid bonding agent is inhibited, the fragile nature of the liquid bonding agent after the solidification is reduced producing an optical device substrate with improved mechanical strength and an insulation layer of precisely controlled thickness.

18 Claims, 8 Drawing Sheets



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C09J 5/02	(2006.01)
B32B 27/00	(2006.01)
B32B 7/00	(2006.01)
B32B 9/00	(2006.01)
B32B 15/04	(2006.01)
B32B 15/08	(2006.01)
B32B 27/38	(2006.01)
H01L 29/18	(2006.01)
H01L 33/00	(2010.01)
H01L 33/64	(2010.01)
H01L 23/00	(2006.01)
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B29C 65/48	(2006.01)
H01L 33/62	(2010.01)

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(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	2001-044317	2/2001	.... H01L 23/12
JP	2003-309292	10/2003	.... H01L 33/00
JP	2009-105270	5/2009	.... H01L 23/36
JP	4925296	4/2012	.... H01L 23/48
KR	10-2007-0039006	4/2007	.... H05K 1/03
KR	10-2010-0110152	10/2010	.... H05K 1/02
WO	WO 2006/070457	7/2006	.... H01L 23/12
WO	WO 2011/122846	10/2011	.... H01L 33/62

* cited by examiner

FIG. 1

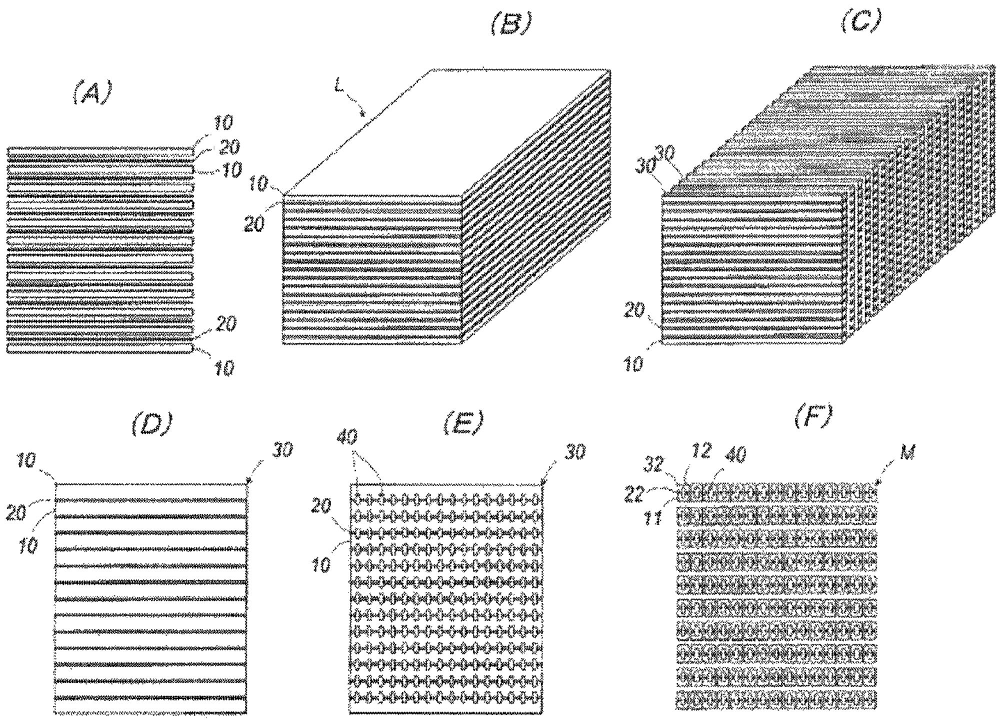

(A)
10
20
10
20
10
(B)
L
10
20
(C)
30
30
20
10
(D)
10
20
10
30
(E)
40
20
10
30
(F)
32
12
40
22
11
M

FIG. 2

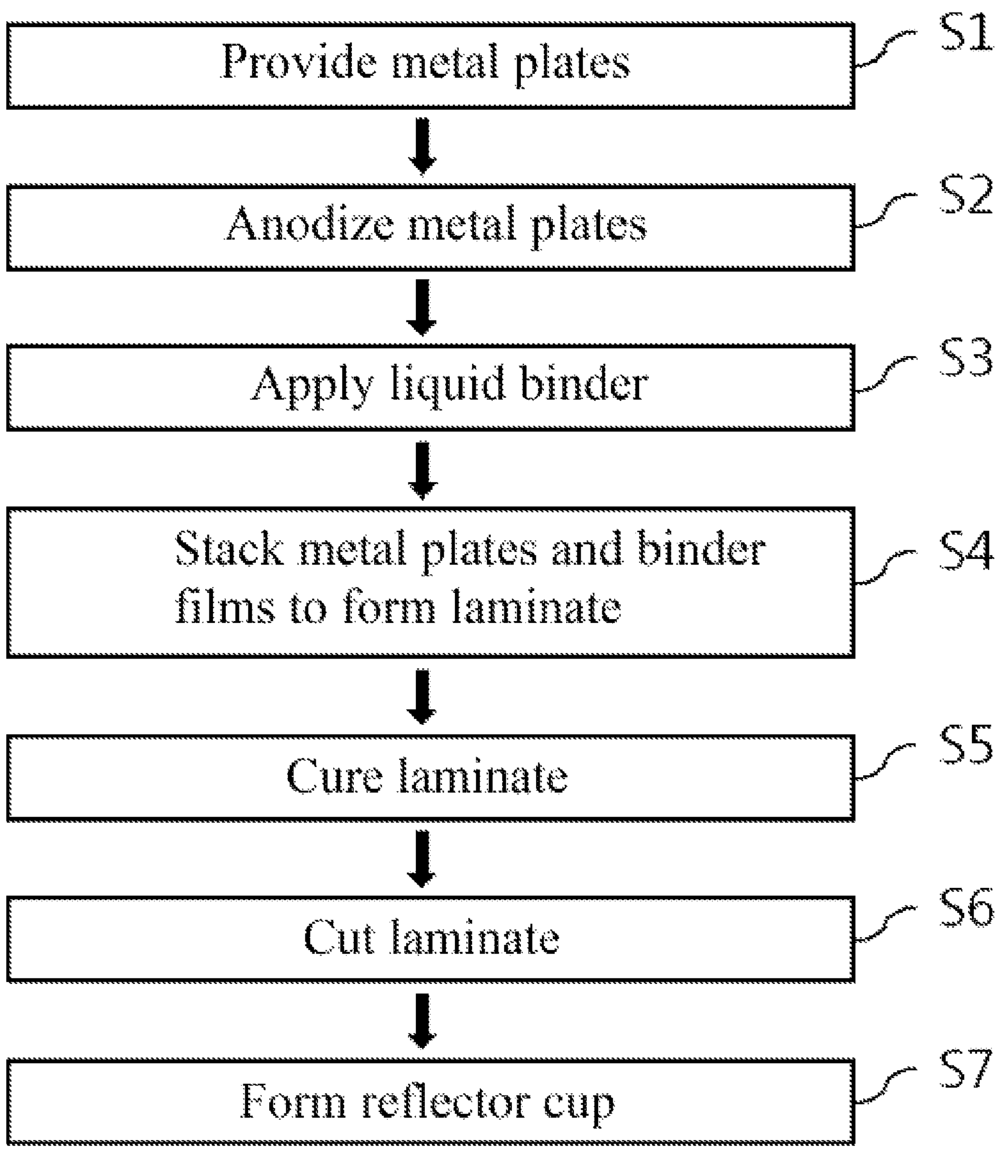

Provide metal plates
S1
Anodize metal plates
S2
Apply liquid binder
S3
Stack metal plates and binder films to form laminate
S4
Cure laminate
S5
Cut laminate
S6
Form reflector cup
S7

FIG. 3

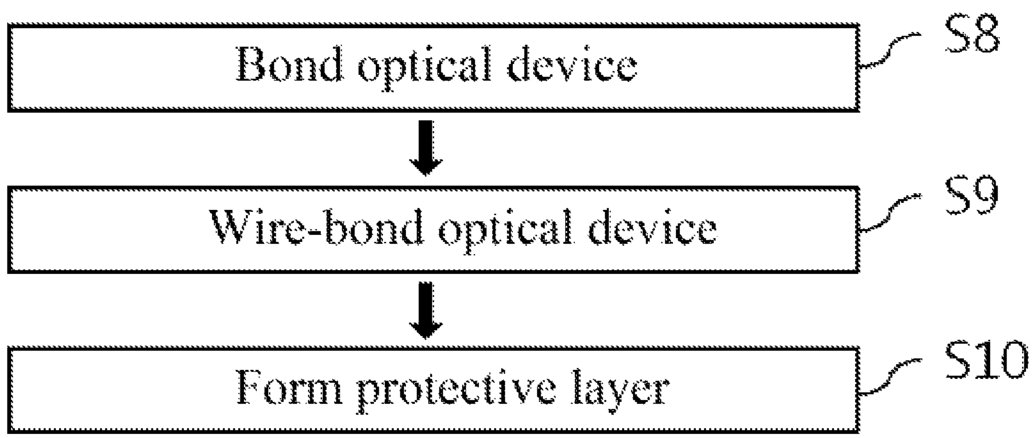

Bond optical device
S8
Wire-bond optical device
S9
Form protective layer
S10

FIG. 4

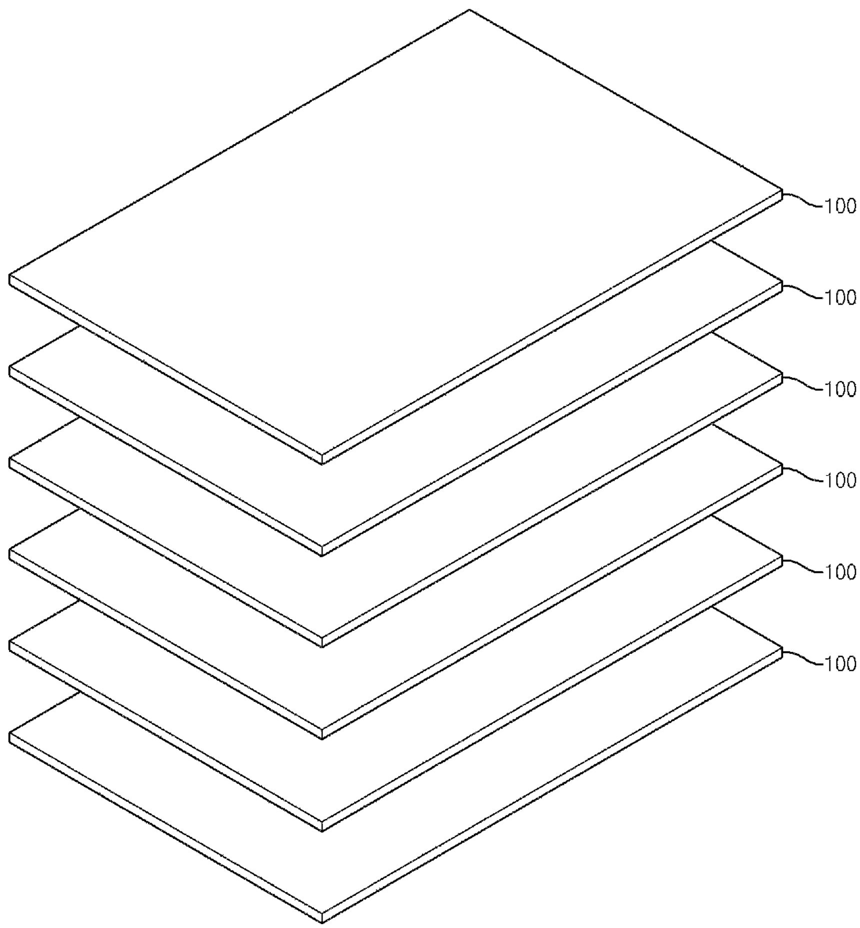


FIG. 5

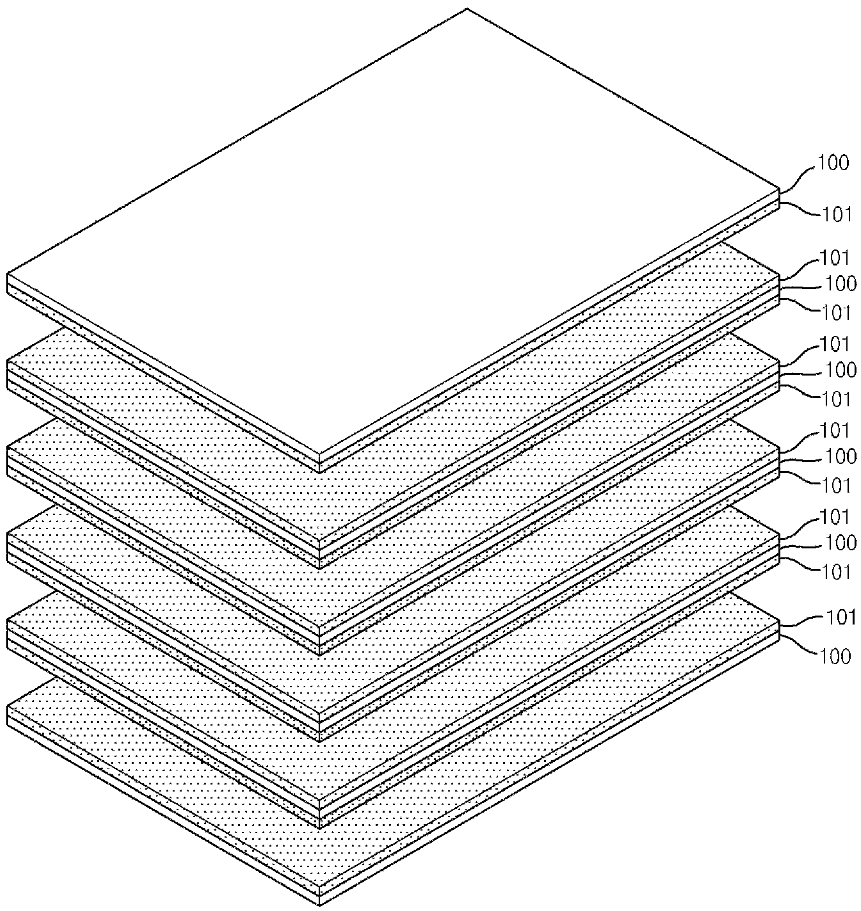


FIG. 6

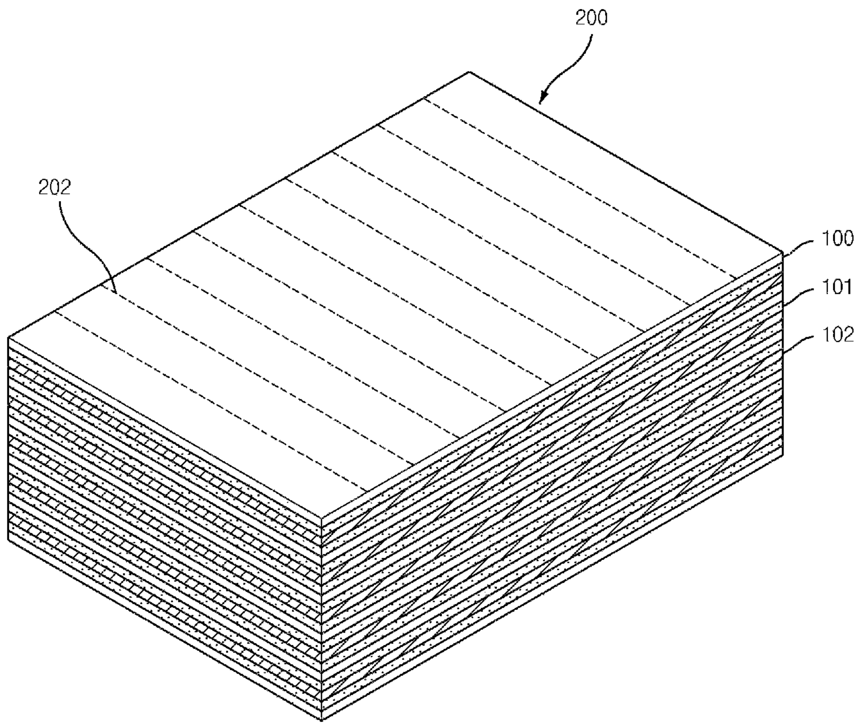


FIG. 7

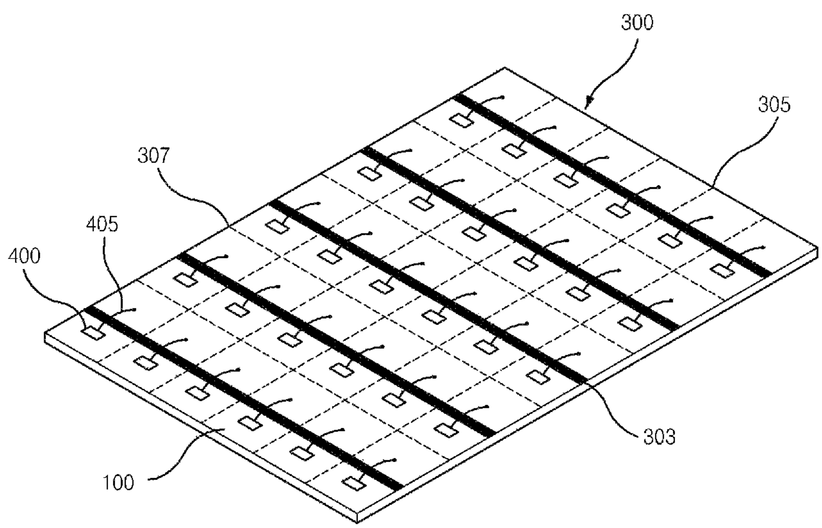

300
305
307
405
400
303
100

FIG. 8

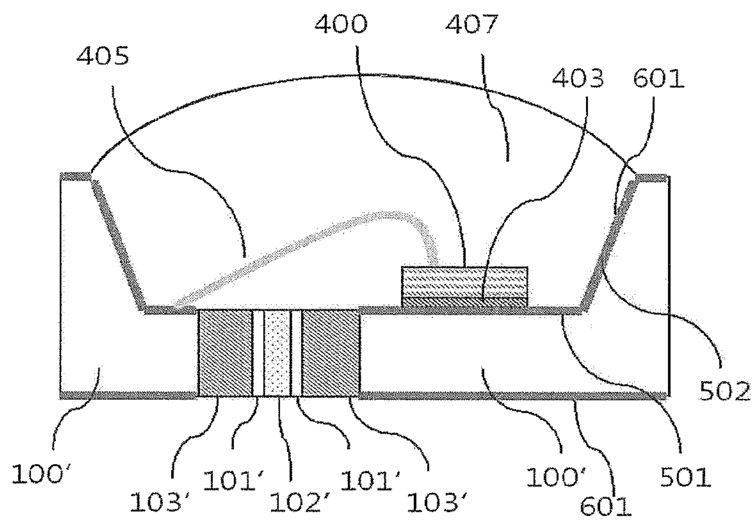
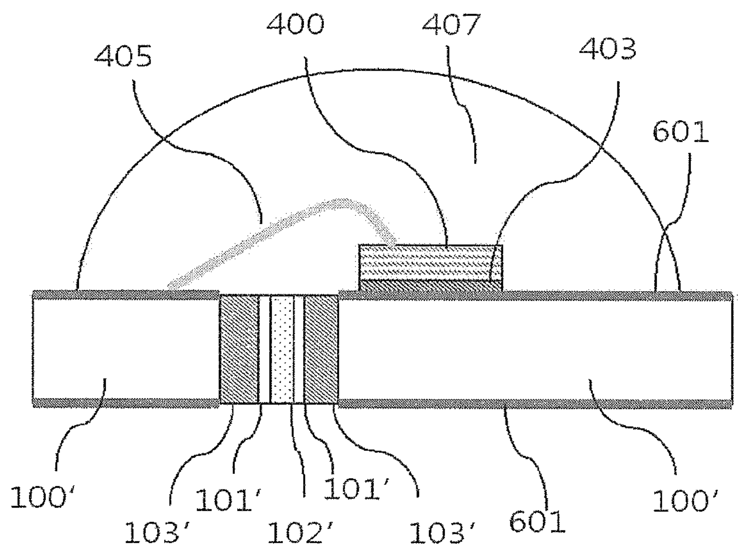

400
407
405
403
601
502
100′
103′
101′
102′
101′
103′
100′
601
501

FIG. 9



HIGH HEAT-RADIANT OPTICAL DEVICE SUBSTRATE AND MANUFACTURING METHOD THEREOF

TECHNICAL FIELD

The present invention relates to an optical device substrate and a method of manufacturing the same, and more particularly, to an optical device substrate, which is superior in interfacial adhesion between a metal layer and an insulating layer and mechanical strength of the insulating layer, and to a method of manufacturing the same.

BACKGROUND ART

Optical devices play a role in converting an electrical signal into light. Typically represented by an optical device, a light emitting diode (LED) has high efficiency and may produce light at high luminance, and the use thereof is thus drastically increasing.

However, because LEDs generate heat in the course of emitting light, they may deteriorate or may negatively affect performance of other parts.

Hence, thorough research is ongoing to manufacture substrates having high mechanical strength while efficiently dissipating heat generated from LEDs, but results thereof are unsatisfactory.

For example, republished Japanese Patent No. WO2006/070457 discloses a highly heat conductive circuit module. As illustrated in (A) to (F) of FIG. **1**, metal layers **10** and insulating resin layers **20** are alternately stacked and then cured, and the resulting laminate L is cut, thus obtaining a package **30** in which the metal layers **10** and the insulating resin layers **20** are alternately shown on the cut surface. Then, electronic parts **40** are disposed on the package **30**, after which the package **30** is longitudinally and transversely cut and divided into individual package pieces **32**, thereby obtaining a plurality of circuit modules M having the metal layers and the insulating layers which are repeated, that is, an optical device substrate.

In such a conventional technique, the laminate including the metal layers **10** and the insulating resin layers **20** which are alternately stacked may be formed by applying a resin paste on the metal layers **10** and then stacking the metal layers, or by alternately stacking the metal layers **10** and the resin films **20**, and to obtain adhesion between the metal layers **10** and the insulating resin layers **20**, the surfaces of the metal layers **10** may be formed with an oxide film and roughened.

However, in the case where an optical device substrate is manufactured by oxidizing the surfaces of the metal layers **10** and then alternately stacking the metal layers **10** and the resin films **20**, pores are present in the oxide layer formed on the metal layer **10** and thus the flat area of the oxide layer in contact with the resin film **20** becomes small, and thereby the metal layer **10** and the insulating resin layer **20** may be undesirably easily separated from each other even by a small force.

Also, in the case where an optical device substrate is manufactured by oxidizing the surfaces of the metal layers **10**, coating the metal layers **10** with only a resin paste, namely, a liquid resin binder and then stacking the metal layers, the resin paste may bubble in the course of thermal curing of the resin paste, and thus mechanical strength of the insulating resin layer **20** may become very weak, undesirably easily breaking the optical device substrate.

Also, in the case where an optical device substrate is manufactured by oxidizing the surfaces of the metal layers **10**, applying only a liquid resin binder and then stacking the metal layers, when the liquid resin binder is cured, its ductility disappears and is easy to break, and thus the insulating resin layer **20** of the optical device substrate may be undesirably easily broken.

Also, in the case where an optical device substrate is manufactured by oxidizing the surfaces of the metal layers **10**, applying only a liquid resin binder and then stacking the metal layers, when the metal layers **10** stacked in a direction of gravity and then pressed using a press are thermally cured, a pressure applied to the lowermost layer and the uppermost layer may vary due to the weight of the metal layers **10**, and thus the thickness of the insulating layers of the optical device substrate becomes very non-uniform.

Also, in the case where an optical device substrate is manufactured by oxidizing the surfaces of the metal layers **10**, applying only a liquid resin binder and then stacking the metal layers, when the viscosity of the liquid resin binder is high, the liquid resin binder does not infiltrate the oxide films formed on the metal layers **10**, whereas when the viscosity thereof is low, the liquid resin binder escapes between the metal layers **10** as soon as the layers are pressed, and undesirably the optical device substrate wherein the insulating layers are only partially provided may be produced.

Also, in the case where an optical device substrate is manufactured by oxidizing the surfaces of the metal layers **10**, applying only a liquid resin binder and then stacking the metal layers, the liquid resin may flow down and thus it is very difficult to form the insulating layers at a predetermined thickness or more.

When only the liquid resin binder is used in this way, the thickness of the insulating layers of the optical device substrate is very difficult to uniformly maintain, thus making it considerably difficult to implement packaging of LED chips located at a predetermined interval on the optical device substrate by an automation system.

In addition, Japanese Patent Application Publication No. Hei. 9-55535 simply discloses fabrication of an optical device substrate by alternately stacking conductive members and epoxy adhesive layers and performing cutting in the same direction as the stacking direction, or by applying a liquid epoxy resin on conductive members, stacking metal layers and performing cutting in the same direction as the stacking direction. Thus, this patent also causes substantially the same problems as in republished Japanese Patent No. WO2006/070457 as above.

DISCLOSURE

Technical Problem

Accordingly, the present invention is intended to provide an optical device substrate and a manufacturing method thereof, wherein an optical device substrate **300** is manufactured by anodizing the surfaces of metal plates **100**, coating the metal plates **100** with an insulative liquid binder **101** having a viscosity adapted to infiltrate the anodized oxide films of the metal plates **100**, alternately stacking the metal plates **100** coated with the liquid binder **101** and insulative binder films **102** before curing the liquid binder **101**, and then performing hot pressing, and thereby, a bonding force between the metal plates **100** and the insulating layers **303** may be enhanced, and simultaneously the liquid binder **101** may be prevented from bubbling during thermal curing, thus enhancing mechanical strength of the optical device substrate **300** and decreasing fragility of the liquid binder after curing, and furthermore, the thickness of the insulating layers **303** of the optical device substrate **300** is made uniform, so that the thickness of the insulating layers **303** of the optical device substrate **300** may be precisely controlled.

Also, the present invention is intended to provide an optical device substrate and a manufacturing method thereof, wherein an insulative liquid binder **101** having a viscosity of 0.1~1 Pa·s at room temperature ranging from 5° C. to 40° C. is applied on the oxide films of metal plates **100**, and thereby the liquid binder **101** may finely infiltrate the oxide films.

Also, the present invention is intended to provide an optical device substrate and a manufacturing method thereof, wherein an insulative liquid binder **101** having a viscosity of 0.01~0.03 Pa·s in the thermal treatment temperature range of 80~100° C. is applied on the oxide films of metal plates **100**, and thereby the liquid binder **101** may finely infiltrate the oxide films.

Also, the present invention is intended to provide an optical device substrate and a manufacturing method thereof, wherein, in the course of a series of anodizing metal plates **100**, coating the anodized metal plates **100** with a liquid binder **101**, alternately stacking the metal plates **100** coated with the liquid binder **101** and insulative binder films **102** to form a laminate and hot pressing the laminate, a pressure applied to both ends of the laminate is set to 2~10 kg/cm^2, and thereby the liquid binder **101** may finely infiltrate the oxide films of the metal plates **100** and excessive mechanical impact may be prevented from being applied to the binder films **102**.

Technical Solution

In order to accomplish the above objects, the present invention provides a method of manufacturing an optical device substrate, including anodizing surfaces of a plurality of metal plates; coating the anodized surfaces of the metal plates with an insulative liquid binder having a viscosity adapted to infiltrate anodized oxide films of the metal plates; alternately stacking the metal plates coated with the liquid binder and insulative binder films, before curing the liquid binder; and curing a laminate including the metal plates and the binder films using hot pressing, so that the liquid binder infiltrates the anodized oxide films of the metal plates.

Also, the method according to the present invention may further include, after curing, cutting the laminate including the metal plates and the binder films in a direction same as a stacking direction, thus forming a plurality of optical device substrates.

Also, in the method according to the present invention, the metal plates may include any one selected from among aluminum, an aluminum alloy, magnesium, and a magnesium alloy.

Also, in the method according to the present invention, the liquid binder and the binder films may include a polymer- or epoxy-based thermosetting resin.

Also, in the method according to the present invention, the viscosity of the liquid binder may be 0.1~1 Pa·s at room temperature ranging from 5° C. to 40° C.

Also, in the method according to the present invention, the liquid binder may have a viscosity of 0.01~0.03 Pa·s in a thermal treatment temperature range of 80~100° C. during heating upon curing.

Also, the method according to the present invention may further include processing the cut surface of the optical device substrate formed upon cutting, thus forming a reflector cup having a bottom surface and an inclined surface extending therefrom.

Also, in the method according to the present invention, a pressure applied to both ends of the laminate including the metal plates and the binder films upon curing may be 2~10 kg/cm^2.

Also, the method according to the present invention may further include plating the optical device substrate with any one or more selected from among silver (Ag), gold (Au), nickel (Ni), copper (Cu), and palladium (Pd).

Advantageous Effects

According to the present invention, an optical device substrate **300** is manufactured by anodizing the surfaces of metal plates **100**, coating the metal plates **100** with an insulative liquid binder **101** having a viscosity adapted to infiltrate the anodized oxide films of the metal plates **100**, alternately stacking the metal plates **100** coated with the liquid binder **101** and insulative binder films **102** before curing the liquid binder **101**, and performing hot pressing, and thereby, a bonding force between the metal plates **100** and the insulating layers **303** can be enhanced, and simultaneously the liquid binder **101** can be prevented from bubbling during thermal curing, thus enhancing mechanical strength of the optical device substrate **300** and decreasing fragility of the liquid binder after curing, and furthermore, the thickness of the insulating layers **303** of the optical device substrate **300** is made uniform, so that the thickness of the insulating layers **303** of the optical device substrate **300** can be precisely controlled.

Also, according to the present invention, the insulative liquid binder **101** having a viscosity of 0.1~1 Pa·s at room temperature ranging from 5° C. to 40° C. is applied on the oxide films of the metal plates **100**, and thereby the liquid binder **101** can finely infiltrate the oxide films.

Also, according to the present invention, the insulative liquid binder **101** having a viscosity of 0.01~0.03 Pa·s in the thermal treatment temperature range of 80~100° C. is applied on the oxide films of the metal plates **100**, and thereby the liquid binder **101** can finely infiltrate the oxide films.

Also, according to the present invention, in the course of a series of anodizing the metal plates **100**, coating the anodized metal plates **100** with the liquid binder **101**, alternately stacking the metal plates **100** coated with the liquid binder **101** and the insulative binder films **102** to form a laminate and hot pressing the laminate, a pressure applied to both ends of the laminate is set to 2~10 kg/cm^2, and thereby the liquid binder **101** can finely infiltrate the oxide films of the metal plates **100** and excessive mechanical impact can be prevented from being applied to the binder films **102**.

DESCRIPTION OF DRAWINGS

FIG. **1** is of views illustrating individual steps of a process of manufacturing an optical device substrate according to a conventional technique;

FIG. **2** is a flowchart illustrating a process of manufacturing an optical device substrate according to the present invention;

FIG. **3** is a flowchart illustrating individual steps of a process of packaging an optical device on the optical device substrate according to the present invention;

FIGS. **4** to **7** are views illustrating individual steps of the process of manufacturing an optical device substrate according to the present invention; and

FIGS. **8** and **9** are views illustrating an LED packaged on the optical device substrate according to the present invention.

MODE FOR INVENTION

Hereinafter, a detailed description will be given of the present invention with reference to the appended drawings.

FIG. **2** is a flowchart illustrating a process of manufacturing an optical device substrate according to an embodiment of the present invention, and FIG. **3** is a flowchart illustrating individual steps of a process of packaging an optical device on the optical device substrate according to the present invention.

As illustrated in FIG. **2**, the method of manufacturing the optical device substrate according to the present invention includes providing metal plates **100** (S**1**), anodizing the metal plates **100** (S**2**), applying a liquid binder **101** on the anodized surfaces of the metal plates **100** (S**3**), alternately stacking the metal plates **100** coated with the liquid binder **101** and binder films **102** (S**4**), curing a laminate including the metal plates **100** and the binder films **102** using hot pressing (S**5**), cutting the laminate including the metal plates **100** and the binder films **102** in the same direction as the stacking direction (S**6**), and processing the cut surface of the resulting substrate to form a reflector cup having a bottom surface **501** and an inclined surface **502** extending therefrom (S**7**).

As illustrated in FIG. **3**, packaging an optical device **400** on the optical device substrate **300** according to the present invention includes bonding an optical device **400** to the optical device substrate **300** (S**8**), wire-bonding the optical device **400** to an electrode **100'** (S**9**), and forming a protective layer **407** to enclose the optical device **400** and the conductive wire **405**.

Below is a detailed description of the method of manufacturing the optical device substrate **300** as illustrated in FIG. **2** and the packaging of the optical device **400** as illustrated in FIG. **3**, with reference to FIGS. **4** to **9**.

Upon providing the metal plates **100** (S**1**), as illustrated in FIG. **4**, a plurality of metal plates **100** is provided, and preferably, the metal plates **100** have a rectangular shape and are made of aluminum, an aluminum alloy, magnesium or a magnesium alloy. The other shapes or materials may be adopted, as necessary.

Subsequently, upon anodizing (S**2**), the metal plates **100** have porous oxide films formed on the surfaces thereof by means of an anodizing process. Because the formed oxide films have a large surface area, a bonding force between the metal plates **100** and the liquid binder **101** which will be subsequently applied thereon may be enhanced, and also insulating properties between the metal plates **100**, namely, voltage resistance, may be improved. As such, the anodizing process is typical and a description thereof is thus omitted.

Subsequently, upon applying the liquid binder **101** (S**3**), as illustrated in FIG. **5**, the anodized surfaces of the metal plates **100** are coated with an insulative liquid binder **101**.

As such, the liquid binder **101** has a viscosity adapted to infiltrate pores of the oxide films formed on the metal plates **100**, so that the liquid binder **101** finely infiltrates the oxide films. Thereby, the bonding area between the liquid binder **101** and the oxide films may be enlarged, thus enhancing the bonding force between the liquid binder **101** and the metal plates **100**.

In order to allow the liquid binder **101** to finely infiltrate the oxide films, the viscosity of the liquid binder **101** at room temperature ranging from 5° C. to 40° C. is preferably set to 0.1~1 Pa·s.

Selectively, in order to enable the liquid binder **101** to finely infiltrate the oxide films, the viscosity of the liquid binder **101** is preferably set to 0.01~0.03 Pa·s in the thermal treatment temperature range of 80~100° C. in the course of heating in the subsequent curing step. In this case, the liquid binder **101** may finely infiltrate the oxide films in the thermal treatment temperature range of 80~100° C., and the viscosity thereof is drastically increased while gradually increasing the thermal treatment temperature from 100° C. to 200° C., so that this binder is cured in a state of finely infiltrating the oxide films.

The liquid binder **101** may be made of a polymer- or epoxy-based resin, and a thermosetting resin may be used so as to prevent changes in phase under external conditions after curing.

Subsequently, upon stacking the metal plates **100** and the insulative binder films **102** (S**4**), as illustrated in FIG. **6**, before the liquid binder **101** applied on the metal plates **100** is cured, the metal plates **100** coated with the liquid binder **101** and a plurality of insulative resin binder films **102** are alternately stacked to form a laminate. The resin binder films **102** may be formed of a polymer- or epoxy-based resin, and a thermosetting resin may be used so as to prevent changes in phase under external conditions after curing.

In the case where an optical device substrate **300** is manufactured by stacking the metal plates **100** coated with only the insulative liquid binder **101**, the liquid binder **100** may bubble upon thermal curing, and thus the insulating layers **303** of the optical device substrate **300** are remarkably decreased in mechanical strength, undesirably making it easy to break the optical device substrate **300**. However, in the present invention, when an optical device substrate **300** is manufactured by stacking the metal plates **100** coated with the insulative liquid binder **101** and the insulative resin binder films **102**, bubbling of the liquid binder **101** may be suppressed during thermal curing, and thereby mechanical strength of the optical device substrate **300** may be enhanced and fragility of the liquid binder after curing may be decreased.

Also, in the case where an optical device substrate **300** is manufactured by stacking the metal plates **100** coated with only the insulative liquid binder **101**, the liquid resin may flow down and thus the thickness of the insulating layers **303** of the optical device substrate **300** may become very non-uniform, and also it is very difficult to manufacture the optical device substrate **300** having the insulating layers **303** at a predetermined thickness or more. However, in the present invention, as an optical device substrate **300** is manufactured by stacking the metal plates **100** coated with the insulative liquid binder **101** and the insulative resin binder films **102**, the thickness of the insulating layers **303** of the optical device substrate **300** is made uniform, and may also be precisely controlled.

Subsequently, upon curing (S**5**), the laminate including the metal plates **100** and the binder films **102** is hot pressed, so that the applied liquid binder **101** and the binder films **102** are cured. As such, when the pressure applied to both ends of the laminate is 2~10 kg/cm^2, the liquid binder may finely infiltrate the oxide films of the metal plates and also excessive mechanical impact may be prevented from being applied to the binder films.

Subsequently, upon cutting the laminate **200** (S**6**), the cured laminate **200** including the metal plates **100** and the binder films **102** is cut in the same direction as the stacking direction. For example, when the laminate **200** is cut in the same direction as the stacking direction of the laminate **200** based on the cut lines **202** as illustrated in FIG. **6**, rectangular optical device substrates **300** may be manufactured, with a predetermined thickness and including the metal layers **100'** and the insulating layers **303** which are repeated, as illustrated in FIG. **7**.

Thereafter, forming the reflector cup (S**7**) may be further performed. As illustrated in FIG. **8**, the cut surface of the optical device substrate **300** is processed using a cutting tool, thus forming a reflector cup having a bottom surface **501** and an inclined surface **502** extending therefrom. Such a reflector cup is effective at emitting light forward from the optical device **400**.

Before or after forming the reflector cup (S7), forming a plating layer **601** on the optical device substrate **300** may be implemented. The plating layer **601** functions to increase reflectivity of light generated from the optical device **400** to thus increase light efficiency, and also to improve welding properties of a conductive wire **405** to the optical device substrate **300** in the subsequent wire-bonding procedure, thus enhancing bondability.

As such, the plating layer **601** may be formed of any one or more selected from among silver (Ag), gold (Au), nickel (Ni), copper (Cu), and palladium (Pd), and the plating layer may be formed using electric plating or electroless plating.

Selectively, the upper surface of the optical device substrate **300** on which an optical device **400** is mounted is plated with Ag having high reflectivity to increase light reflectivity, and the lower surface of the optical device substrate **300** is plated with Ag, Au or Cu having good bondability to solder balls, thus enhancing soldering properties upon mounting the optical device substrate **300** on a printed circuit board (PCB).

Subsequently, as illustrated in FIG. **7**, upon bonding the optical device (S**8**), a plurality of LED devices **400** is bonded at a predetermined interval to the metal layer **100'** of the optical device substrate **300**. Then, upon wire-bonding (S9), the LED devices **400** each are wire-bonded to the edge of one side of the metal layer **100'** facing thereto with the insulating layer **303** being interposed therebetween. Then, upon forming the protective layer **407** (S**10**), the protective layer **407** is formed on the LED devices **400**. Herein, bonding the LED devices **400** to the metal layer **100'**, wire-bonding the LED devices **400**, and forming the protective layer **407** on the LED devices **400** are typical and thus a detailed description thereof is omitted.

Thereafter, when the packaged optical device substrate **300** is cut in a transverse direction and a longitudinal direction along the cut lines **305**, **307** of FIG. **7**, as illustrated in FIGS. **8** and **9**, each LED device **400** may constitute a single optical device packaging module. Alternatively, when the packaged substrate is cut only in a longitudinal direction along the cut lines **307** of FIG. **7**, a plurality of LED devices **400** may constitute a single optical device packaging module.

The packaged optical device substrate **300** is configured as illustrated in FIGS. **8** and **9**, wherein the metal electrodes **100'** are derived from the metal plate **100**, and the insulating layers **101'**, **102'**, **103'** are respectively derived from the insulative liquid binder **101**, the insulative binder film **102**, and the oxide film of the metal plate **100**. Two metal electrodes **100'** are spaced apart from each other by the insulating layers **101'**, **102'**, **103'**, and the optical device **400** is bonded to one metal electrode **100'** of the two metal electrodes **100'** and wire-bonded to the other metal electrode **100'**, and is also sealed by the protective layer **407**. Therefore, because the optical device is bonded onto the metal electrodes, heat dissipation becomes very effective.

Although the embodiments of the present invention regarding the high heat-radiant optical device substrate and the method of manufacturing the same have been disclosed for illustrative purposes, those skilled in the art will appreciate that a variety of different variations and modifications are possible, without departing from the spirit and scope of the invention. Thus, the above embodiments should be understood not to be limited but to be illustrated.

The scope of the present invention should be determined by the claims which will be described later, and should be understood to incorporate all variations, equivalents and modifications within the spirit and scope of the present invention defined by the claims.

<Description of the Reference Numerals in the Drawings>

100: metal plate	101: liquid binder
102: binder film	200: laminate
300: optical device substrate	303: insulating layer
202, 305, 307: cut line	400: optical device, LED
405: conductive wire	407: protective layer
501: bottom surface	502: inclined surface
601: plating layer	
100': metal layer, metal electrode	
101', 102', 103': insulating layer	

The invention claimed is:

1. A method of manufacturing an optical device substrate, comprising:

anodizing surfaces of a plurality of metal plates;

coating anodized surfaces of the metal plates with an insulating liquid binder having a viscosity adapted to infiltrate anodized oxide films of the metal plates;

alternately stacking the metal plates coated with the liquid binder and insulating binder films, before curing the liquid binder; and

curing a laminate comprising the metal plates and the binder films using hot pressing, so that the liquid binder infiltrates the anodized oxide films of the metal plates.

2. The method of claim **1**, further comprising, after curing, cutting the laminate comprising the metal plates and the binder films in a direction same as a stacking direction, thus forming a plurality of optical device substrates.

3. The method of claim **2**, wherein the metal plates comprise any one selected from among aluminum, an aluminum alloy, magnesium, and a magnesium alloy.

4. The method of claim **3**, wherein the liquid binder and the binder films comprise a polymer- or epoxy-based thermosetting resin.

5. The method of claim **4**, wherein the viscosity of the liquid binder is 0.1~1 Pa·s at room temperature ranging from 5° C. to 40° C.

6. The method of claim **4**, wherein the liquid binder has a viscosity of 0.01~0.03 Pa·s in a thermal treatment temperature range of 80~100° C. during heating upon curing.

7. The method of claim **4**, further comprising processing a cut surface of the optical device substrate formed upon cutting, thus forming a reflector cup having a bottom surface and an inclined surface extending therefrom.

8. The method of claim **4**, wherein a pressure applied to both ends of the laminate comprising the metal plates and the binder films upon curing is 2~10 kg/cm^2.

9. The method of claim **7**, further comprising plating the optical device substrate with any one or more selected from among silver (Ag), gold (Au), nickel (Ni), copper (Cu), and palladium (Pd).

10. An optical device substrate, manufactured by the method of claim **1**.

11. An optical device substrate, manufactured by the method of claim **2**.

12. An optical device substrate, manufactured by the method of claim **3**.

13. An optical device substrate, manufactured by the method of claim **4**.

14. An optical device substrate, manufactured by the method of claim **5**.

15. An optical device substrate, manufactured by the method of claim **6**.

16. An optical device substrate, manufactured by the method of claim **7**.

17. An optical device substrate, manufactured by the method of claim **8**.

18. An optical device substrate, manufactured by the method of claim **9**.

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